REMARKS

Reconsideration and withdrawal of the rejections made in the mentioned Office Action are respectfully requested, in view of the foregoing amendments and the following remarks.

Summary of Amendments

By the foregoing amendments claims 31-55 are canceled and new claims 85-111 are added, whereby claims 56-111 are pending in the present application. Claims 56, 76, 85 and 104 are independent claims. Support for the added claims can be found throughout the present specification and, in particular, in claims 56-84. In this regard, it is noted that new independent claims 85 and 104 differ from independent claims 56 and 76, *inter alia*, in that they recite an aluminum content of 0.002 to 0.65 weight percent.

It is noted that the cancellation of claims 31-55 is without prejudice or disclaimer, and Applicants expressly reserve the right to prosecute these claims in one or more divisional and/or continuation applications.

Summary of Office Action

As an initial matter, Applicants note with appreciation that the claim for foreign priority under 35 U.S.C. § 119(a)-(d) and receipt of the certified copies of the priority

documents in this National Stage application from the International Bureau have been acknowledged in the present Office Action and that an initialed and signed copy of the Form PTO-1449 filed January 3, 2002 has been returned together with the Office Action.

The Restriction Requirement mailed January 24, 2003 is made final and claims 31-55 are withdrawn from consideration.

The Examiner, in Section 2 of the Office Action (Claim Interpretation), notes that the phrase "more than 0.5 to 5.9 vanadium" recited in claim 56 is interpreted to mean "more than 0.5", but less than or equal to 5.9.

Claims 56-63, 66-71, 73-77, 83, and 84 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Nawata et al., U.S. Patent No. 5,305,522 (hereafter "NAWATA").

Claims 56-63, 66, 68, 69, 71, 73-75 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over EP 665068 A1 (hereafter "EP'068").

Claims 76, 77, 83, and 84 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over EP'068 in view of NAWATA.

Claims 64, 65, 72 and 78-80 are objected to as being dependent upon a rejected base claim, but are indicated to be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Response to Office Action

Reconsideration and withdrawal of the rejections of record are respectfully requested.

Response to Claim Interpretation

The Examiner notes that the phrase "more than 0.5 to 5.9 vanadium" recited in claim 56 is interpreted to mean "more than 0.5", but less than or equal to 5.9. Applicants confirm that the Examiner's understanding is correct. However, this confirmation is not to be construed as Applicants' surrender of any scope of equivalents.

Response to Rejection of Claims under 35 U.S.C. 103(a) over NAWATA

Claims 56-63, 66-71, 73-77, 83, and 84 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over NAWATA. In particular, the rejection alleges that NAWATA teaches a compound roll having a shell portion made of a hard cast iron comprising the composition which is given in, e.g., the Abstract of NAWATA and which, according to the Office Action, substantially overlaps with the composition recited in the rejected claims. The rejection also asserts that at column 2, lines 3-4 and column 3, line 32 NAWATA teaches that the graphite particle population is dependent on the carbon content and that at column 2, lines 47-48 of NAWATA it allegedly is taught that the shell portion has excellent wear resistance and resistance to surface roughening.

With respect to claim 76, the Office Action asserts that according to the abstract of NAWATA, the core portion of the compound roll of is made of a tough cast iron or steel (which allegedly broadly overlaps with the presently claimed low-alloy cast iron), while the shell portion is made of hard cast iron. The rejection also contends that the according to col. 9, lines 51-52 of NAWATA, the thickness of the shell portion typically is 70 mm and that this document teaches (col. 3, line 55 and col. 4, lines 10 and 17) that by incorporating Mn, Ni and Cr a hard phase of martensite can be formed in the alloy.

The Examiner acknowledges that NAWATA fails to teach a) the amount or distribution of precipitated graphite particles, b) the amount of precipitated eutectic and monocarbides, and c) the Shore C hardness recited in independent claims 56 and 76, respectively, but essentially takes the position that it would have been obvious to one of ordinary skill in the art to determine the optimum values of a) and b), because NAWATA allegedly teaches in column 2, lines 3-4 and 7-16 and column 3, line 32 thereof that graphite and carbide precipitates depend on composition and cooling rate and that poor wear resistance and surface roughening occur when too many graphite particles and too few carbide particles are present. With respect to feature c), the rejection contends that the claimed products and the products of NAWATA are identical or substantially identical in structure and composition, wherefore substantially the same Shore C hardness can allegedly be expected. Corresponding arguments are applied with respect to the value of the bending

strength recited in present claim 84.

Regarding claim 83, the rejection contends that the "ductile iron" of the core part of the claimed chill roll recited therein is within the scope of NAWATA's alleged teaching of using a tough cast iron or cast steel.

Applicants respectfully disagree with the Examiner's analysis of NAWATA and the conclusions drawn therefrom for at least the following reasons.

The Office Action contends that NAWATA teaches that graphite and carbide precipitates depend on composition and cooling rate and that poor wear resistance and surface roughening occur when too many graphite particles and too few carbide particles are present. In this regard, the Examiner appears to rely on column 2, lines 3-16 of NAWATA where the following is stated:

> The high-alloy cast iron is a material in which graphite particles are inherently likely to be precipitated. Accordingly, in the case of forming the shell portion from the high-alloy cast iron, a surface portion of the shell portion not only has a fine metal structure but also contains fine graphite particles and a fine carbide phase by the rapid cooling action of the mold. However, since the rapid cooling action of the mold decreases inside the shell portion, the metal structure becomes coarser and the amount of graphite particles precipitated increases while the amount of the carbide phase decreases. As a result, in the deep area of the shell portion, which is to be exposed by several times of machining, it shows poor resistance to wear and surface roughening.

Accordingly, what may possibly be inferred from the above passage of NAWATA is that poor resistance to wear and surface roughening are a result of one or more of the

following factors: the metal structure becomes coarser; the amount of graphite particles increases; the amount of the carbide phase decreases. Without hindsight, this teaching can not be taken as a suggestion to optimize both the number of graphite particles and the volume fraction of graphite.

Moreover, the following is stated in col. 5, lines 24-44 of NAWATA:

> It is preferable that the graphite particles in the metal structure of the shell portion have an average diameter of 65 μm or less in a range from a surface to a depth of 50 mm when determined by an image analysis method on the graphite particles having diameters exceeding 28 μm. If the average diameter of the graphite particles is larger than 65 μm, good wear resistance and resistance to surface roughening, which are required to the shell portion, cannot be achieved, failing to produce high-quality rolled sheets.

Accordingly, NAWATA teaches which property of the graphite particles adversely affects wear resistance and resistance to surface roughening, i.e., an average diameter of the graphite particles which is larger than 65 μm. No other properties of the graphite are mentioned in this regard. Thus, in light of NAWATA one of ordinary skill in the art would not have had any motivation to pay close attention to any property of the graphite particles other than the size thereof, such as, e.g., the number and the volume fraction thereof.

In this regard, it also is pointed out that from, e.g., col. 7, lines 4-21 of NAWATA, it appears that even the size of the graphite particles is not as important a factor for the quality of the roll as two other parameters, i.e., the size and the uniformity of the size in the radial

direction, of the primary precipitated particles (as defined in col. 6, lines 47-52).

However, even if it were assumed, *arguendo*, that NAWATA contains a suggestion to optimize the number of graphite particles in order to obtain high wear resistance and low surface roughness, NAWATA certainly does not provide any teaching or suggestion that both the number and the volume percentage of graphite particles need to be optimized in order to obtain a satisfactory roll performance. By contrast, a comparison of the performance of the rolls listed in Table 1 of the present application clearly shows that the number of graphite particles is only one of the determining factors in this regard, the volume percentage of the particles (and the composition of the alloy) playing a significant role as well. Since NAWATA clearly lacks any teaching or suggestion to optimize the volume percentage of the graphite particles, NAWATA does not render obvious the subject matter recited in the present claims for this reason alone.

In view of the foregoing, there appears to be no need to comment on any of the Examiner's additional allegations regarding NAWATA. However, this must not be construed as Applicants' admission that any of these other allegations are of merit.

Accordingly, Applicants submit that at least for the reasons discussed above, the rejection of claims 56-63, 66-71, 73-77, 83, and 84 under 35 U.S.C. § 103(a) as obvious over NAWATA is not tenable, wherefore withdrawal of this rejection is respectfully requested.

Response to Rejection of Claims under 35 U.S.C. 103(a) over EP'068

Claims 56-63, 66, 68, 69, 71, 73-75 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over EP'068. In this regard, the rejection alleges that EP'068 teaches a wear and seizing resistant compound roll for hot rolling having an outer portion made of a hard cast iron comprising a composition as shown in the abstract and at page 4, lines 7-9 of EP'068. According to the rejection, this composition overlaps with the presently claimed composition ranges. The rejection further contends that EP'068 teaches that said alloy has a metal structure comprising a matrix comprising martensite, 0.5-5% in area ratio of graphite, 0.2-10% in area ratio of MC carbides, and 0.2-20% other carbides, MC carbides including vanadium carbides and "other carbides" including eutectic carbides.

The Examiner acknowledges that EP'068 fails to teach the number and distribution of graphite particles as recited in the present independent claims, but takes the position that in view of the allegedly overlapping area ratios, the number of particles per mm^2 is expected to overlap. Corresponding arguments are applied with respect to the remaining features recited in the rejected claims in light of the alleged overlap in composition.

Applicants respectfully traverse this rejection as well. In particular, even if it were assumed, *arguendo*, that the area ratio of graphite particles (0.5-5%) indicated in EP'068 overlaps with the area ratio of the graphite particles according to the present invention, the

Examiner has not offered any explanation as to why "the amount of particles/mm^2 is also expected to overlap". Obviously, the number of graphite particles/mm^2 depends not only on the area ratio, but also on the size of the graphite particles. For example, Samples C and H listed in Table 1 at page 17 of the present application contain the same volume fraction of graphite (2.8 %), but a significantly different number of graphite particles per mm^2, i.e., 21 vs. 37. Samples D and F in said Table 1 may also be referred to in this regard. While Sample D contains more than twice the volume fraction of graphite of Sample F (3.9 % vs. 1.7 %), it contains less than half the number of graphite particles/mm^2 (18 vs. 42).

While EP'068 does indicate a graphite particle size of 5-50 μm (page 4, line 50), it does not provide any teaching regarding a suitable correlation between particle size and area ratio, and certainly does not contain any teaching or suggestion that the number of graphite particles is of any significance with respect to the properties of the roll for hot rolling discussed therein, thereby failing to provide any motivation to one of ordinary skill in the art to optimize the number of graphite particles.

In addition, a closer look at the teaching of EP'068 and, particularly, the preferred embodiments thereof, shows that this document is directed to an invention which is genuinely different from the invention recited in the present claims, wherefore this document does not render obvious the present invention for this reason alone. For example, according to EP'068 the most preferred concentration of Mo is 3.0-6.0 wt-% (page 5, line 57), whereas, e.g.,

independent claim 56 recites 0.20-2.9 wt-% of Mo. Moreover, Ni is not even a mandatory element of the alloy of EP'068. If present at all, the most preferred concentration of Ni according to EP'068 is 0.5-2.0 wt-% (page 6, line 6), whereas claim 56 recites 3.5-4.9 wt-% of Ni. Moreover, although not mandatory, the alloy of EP'068 may contain (and preferably contains) substantial amounts of Co and W (up to 10 wt-% each; see, e.g., claims 4 and 5 of EP'068), preferably 3.0-7.0 wt-% of Co (page 6, line 29), and 2.0-6.0 wt-% of W (page 6, line 22). By comparison, according to the present invention, W and Co do not play any particularly desirable role.

This inherent difference in composition between the alloy of the present invention and the alloy of EP'068 is reflected by the fact that according to EP'068 a special technique is resorted to in order to achieve the desired amounts (in terms of area ratio) of graphite. In particular, at page 4, lines 10-24 of EP'068 the following is stated:

> The method of producing the wear- and seizing-resistant compound roll for hot rolling according to the present invention is characterized in supplying an Si-containing inoculant at least in a vicinity of the bonding portion of the melt for the outer layer and the steel shaft.
>
> Preferably, the method of producing the wear- and seizing-resistant compound roll for hot rolling according to the present invention comprises the steps of introducing the steel shaft concentrically into an inner space of a composite mold comprising a refractory mold surrounded by an induction heating coil and a cooling mold provided under the refractory mold concentrically therewith; pouring a melt of the iron-based alloy into a space between the steel shaft and the composite mold; keeping the melt at a temperature between a primary crystal-crystallizing temperature and a temperature 100 °C higher than

> the primary crystal-crystallizing temperature under heating with stirring while sealing the surface of the melt by a flux; moving the steel shaft downward concentrically with the composite mold to bring the melt into contact with the cooling mold thereby solidifying the melt to bond to the steel shaft so that the outer layer is continuously formed on the steel shaft body, during the formation of the outer layer an Si-containing inoculant is injected by means of wire-injection method into a vicinity of the bonding portion of the melt and the steel shaft to crystallize graphite particles in a sufficient amount.

Emphasis added. Accordingly, it appears that the alloy of EP'068 is not even capable of forming a sufficient amount of graphite unless very sophisticated and unusual steps (inoculation of the melt with a Si-wire) are taken. Moreover, the above passage makes it clear that it is only the amount of graphite, but not the number of graphite particles, that one needs to be concerned about according to EP'068.

In view of the foregoing, there appears to be no need to comment on any of the Examiner's additional allegations regarding EP'068. However, this must not be construed as Applicants' admission that any of these other allegations are of merit.

Applicants respectfully submit that for at least the foregoing reasons, EP'068 does not render obvious any of the subject matter recited in claims 56-63, 66, 68, 69, 71, and 73-75. Accordingly, the rejection of these claims under 35 U.S.C. § 103(a) as allegedly unpatentable over EP'068 is not justified and should be withdrawn, which action is respectfully requested.

Response to Rejection of Claims under 35 U.S.C. 103(a) over EP'068 in view of NAWATA

Claims 76, 77, 83 and 84 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over EP'068 in view of NAWATA. In particular, the rejection alleges that EP'068 teaches a wear and seizing resistant compound roll for hot rolling having an outer portion made of a hard cast iron comprising a composition as shown in the abstract and at page 4, lines 7-9 of EP'068, as well as containing graphite particles, eutectic carbides and vanadium carbides within the presently claimed ranges.

The Examiner acknowledges that EP'068 does not mention a) that the core of the composite chill roll is a low alloy cast iron or b) the Shore C hardness, but asserts that NAWATA teaches that the core portion of the compound roll is made of a tough cast iron or cast steel. According to the rejection, it would allegedly have been obvious to one of ordinary skill in the art to use a tough low alloy cast iron or cast steel for the core portion (as allegedly taught by NAWATA) of the compound roll for roll forming with the shell of EP'068, because NAWATA allegedly teaches that it is conventional to have a hard outer layer and a ductile and tough inner layer in order to provide a compound roll with excellent properties. Regarding the missing Shore C hardness and the features of claims 83 and 84, the rejection is based on essentially the same arguments as those applied in the rejection over NAWATA.

Applicants respectfully traverse this rejection for at least the same reasons as stated above with respect to the claim rejections over NAWATA and EP'068 individually. In particular, none of these two documents teaches or suggests that both the number and the volume percentage of the graphite particles, in combination with the additional parameters recited in independent claim 76 and the claims dependent therefrom, need to be controlled for achieving a satisfactory performance of the corresponding roll.

In view of the foregoing, there appears to be no need to comment on any of the Examiner's allegations regarding the combination of EP'068 and NAWATA. However, this must not be construed as Applicants' admission that any of these allegations are of merit.

For at least the foregoing reasons, withdrawal of the rejection of claims 76, 77, 83 and 84 under 35 U.S.C. § 103(a) over EP'068 in view of NAWATA is respectfully requested.

Response to Objection to Claims

Claims 64, 65, 72 and 78-80 are objected to as being dependent upon a rejected base claim, but are indicated to be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. In this regard, the Office Action states that "the prior art does not teach or suggest an iron alloy with the presently claimed ranges of C, Si, Mn, Cr, Ni, Mo, V, optionally replaced by Nb and Ta, the instant phase

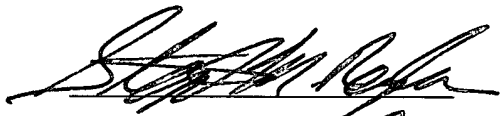
composition(s), complete with the claimed range of aluminum."

In view of the Examiner's comments, new claims 85-111 are submitted herewith. Independent claims 85 and 104 both recite an aluminum content of the alloy. Accordingly, claims 85-111 should be allowable for at least the foregoing reason.

CONCLUSION

In view of the foregoing, it is believed that all of the claims in this application are in condition for allowance, which action is respectfully requested. If any issues yet remain which can be resolved by a telephone conference, the Examiner is respectfully invited to telephone the undersigned at the telephone number below.

Respectfully submitted,
B. FEISTRITZER et al.



Neil F. Greenblum
Reg. No. 28,394

October 1, 2003
GREENBLUM & BERNSTEIN, P.L.C.
1950 Roland Clarke Place
Reston, VA 20191
(703) 716-1191